North Dakota Department of Public Instruction

Business Case
for a

Student Data Analysis and Reporting System

July 8, 2002

Business Requirements:

Statement of problem.

The problem is that NDDPI and the State's public schools have isolated pockets of data, in too many places, and in multiple formats -- without enough access to that data or to meaningful queries and reports on pertinent information. We need to provide access to current and historical data in an effective and efficient manner to make informed education and business decisions. We need a centralized data warehouse and interface for assessment to drive continuous education improvement. That centralized data warehouse needs to be accessible and relatively easy to use so that all stakeholders can have access to relevant data.

    Major process issues that need to be addressed include:
- Poor dissemination of information to process users
- Inconsistent business practices and procedures
- Redundant, non-standardized and fragmented data
- Departmental "shadow" systems
- Lack of true accountability due to inability to frequently and reliably measure / report

Project description from agency's IT plan.

This project is relevant to many of the stated objectives in NDDPI's technology plan:

Technology Access and Use
> Technology access refers to the general infrastructure necessary to provide and maintain effective and efficient technology deployment and connectivity on an equitable basis… The range of technology tools available and the performance capabilities of those tools should be at a level that will support and sustain current learning practices and will also encourage new and innovative learning practices.

Leadership Capacity and Proficiency
> Administrators at the building and district level …should model the effective use of technology in support of learning and administrative functions and be expected to maintain a solid knowledge of the applications of technology to student learning. They should value and foster an environment that encourages teachers to try new approaches to learning and to stretch the limits of what is possible when applying technology to learning. Teachers must be made to feel that they are operating within an environment that values collaboration, experimentation and learning from failure. Administrators should initiate and support professional development processes that reflect attention to principles of adult learning.

Educator Capacity and Proficiency
> Technology in schools has the potential to enhance and transform teaching practices and student learning. It provides opportunities for educators to break through isolation and serves as a catalyst for significant changes in learning practices. .

Professional Development
> … A comprehensive professional development process should be in place to ensure that technology is used effectively to create new opportunities for learning and to promote student achievement. …Professional development programs should be ongoing, tied to curriculum standards, designed with built- in evaluation, and sustained

by adequate financial and staff support. The professional development program should include components such as hands- on technology use, a variety of learning experiences, curriculum- specific applications, new roles for students and teachers, and collaborative learning to name a few.

Perhaps the most compelling section as regards the proposed project is the one stated below:

On- going Evaluation and Continuous Improvement
Federal and state agencies, local school boards and the general public for that matter, require schools to be accountable for their actions. A systematic process should be in place for continuous assessment, evaluation and reporting the extent to which students are progressing and whether educational objectives are being met. Assessment tools should be varied and provide adequate baseline data that will support accountability. Conclusions of instructional results should be communicated and used to support data-driven decisions.

The proposed project is anticipated to squarely match the goal of on-going evaluation and continuous improvement.

Other projects or systems that may be affected.

There are no other technology projects or systems that will be affected. There is an expectation that any data analysis and reporting application would be able to interface with and import information from other school data management applications, e.g. PowerSchool, Sasi XP, Sims, MacSchool or other such applications.

Implications for customer service and gains in efficiency.

Our current methods of data collection result in time-consuming data collection that is subject to much human error. For the proposed project, the inclusion of various elements of student and teacher data from diverse sources into a single relational data warehouse on a single platform with a standard technical architecture will revolutionize our ability to understand, link, and compare data. The system will provide an interactive, powerful, and flexible decision support tool to inform policymakers at all levels of public education.

The system will provide a foundation to frame the educational policy and implementation issues, the consistent data necessary to make informed decisions and a framework to record decisions and monitor conditions.   This data warehousing will open up the door to longitudinal analysis, dis-aggregation, tracking of cohorts and ultimately data mining.

Assessment method used to determine if the project was successful.

We will be able to evaluate the success of the project by comparing the speed and efficiency with which we analyze data after the implementation of the system with the speed and efficiency with which we did so before. Because of the large human element inherent in the use of the proposed data warehouse, we also anticipate soliciting feedback from the customers of NDDPI (the legislature and the public school districts) as well as the staff and customers of the local school districts – board members, administrators, teachers, and parents.   In addition, we will be able to measure the ability to fulfill the reporting requirements of the *No Child Left Behind Act.*

Effect on partners such as other agencies or political subdivisions.

The proposed system is intended to directly benefit the ability of local school systems, as well as state education departments, to access and analyze student information. While there will be no technology effect on other agencies, the ability of the NDDPI to respond to requests for information from other agencies, including the Legislative Assembly, will be greatly enhanced.

Benefit Analysis:

Tangible and intangible project benefits.

The benefits of this project include the enhanced efficiency as set out above as well as the ability of public educators to view and analyze student information in a variety of different ways to satisfy different circumstances. For example, a district could use student assessment and attribute data along with teacher attribute data to form an historical picture of how students with certain attributes perform in the classrooms of teachers with certain attributes. A district could examine an instructional program to determine how students who went through the program fared later in their academic career. Not only are these analyses currently time-consuming and difficult, if not impossible, to perform, they are all too often performed after the fact. The proposed system would allow for ongoing program evaluation and the inevitable mid-course adjustments that will allow school districts to have a positive impact on student learning.

Several of the relevant benefits are as follows:

1) Educational literature for some time now has been pointing to the need for "data driven or fact driven" decision-making. Movement to this operating format is part of a larger change going on in education from a focus on input and process aspects of educational operations to results based systems. Results based systems require extensive capability to review and analyze results data from the system. Student data management and data analysis systems are basic tools in the process of disaggregating and analyzing this data.

2) The new federal legislation "*No Child Left Behind Act*" will require a level of accountability from school districts that they have never experienced before. Reporting adequate yearly progress based on individual student test data and so on will require student data systems and data analyzes in ways that simply cannot be done without the data systems that we are talking about. That is student data management and data analysis systems.

3) The North Dakota legislature has been asking for accountability from schools for a number of years. Both of these data systems will provide the North Dakota legislature with a far greater level of accountability than has ever been possible up to this point. For a cost estimated in the range of $2 million per year this Data Analysis system could provide a very high level of accountability capability from each school district to the legislature. Legislative committees that work with education issues would have access to information necessary to determine the kind of results school districts are achieving with an annual expenditure of $750,000,000. This Data Analysis System would represent a .01% of the total annual expenditure.

4) Student data systems will significantly shorten and simplify school district paperwork and reporting processes. A number of the reports which school districts now provide the department can be rolled up from either student data management or data analysis systems or a combination of both so that reporting will be a matter of printing reports from data which is in one of the two systems.

5) State support of systems like student data management and data analysis systems which all schools will need to meet federal and state requirements and to remain competitive educational operations will be far less costly and far more useful if the state operates systems which all school districts either get on voluntarily in the short term or are required to be on over a longer period of time. Within 5 years, all school systems in ND will need to report data provided by a Data Analysis System.

6) Having a student data system and data analysis systems in North Dakota public schools will provide North Dakota with an edge in terms of recruiting people to live in North Dakota. We will be able to tell potential residents exactly how our schools are doing. In addition, we will be able to reassure them that quality education continues in North Dakota public schools.

7) Currently, district staff and state personnel are attempting to complete analyses and reporting through the use of spreadsheets and stand alone data bases. These efforts require duplicative keypunching of source or pre-aggregated data. Only after the spreadsheet or database is built is the person able to complete limited analyses. The following analysis shows the benefit in timesavings to switch to a rapid analysis and reporting environment driven off of a data warehouse architecture. The minimum estimated to perform hand analyses is 4 hours compared to five minutes required to do the same work with the student data analysis system. Other districts have documented cases up to 40 hours or more to do analyses that can be done in less than an hour with student data analysis systems. For the purposes of this benefit calculation, the assumptions above were used along with the assumption that all analyses performed by hand would take no longer than 4 hours. The result of the analysis is that a total of 257,000+ hours would be saved over a four-year period. At averaged rates for relevant district staff and principals, the four-year economic savings would be $9,288,462 or $79.17 per student. It should be noted that this return is absent the savings associated with the productivity gains of deploying this technology at the teacher level or at the state level. Also, it does not reflect the value created by the redeployment of the 257,000+ hours into valuable knowledge-work. The calculations discussed above are set out in the Figure 1 below. Any efficiency gains through such a system will allow professional staff to concentrate more fully on the content of the analysis and less on the mechanics of producing the data. Such efficiency gains will benefit schools by better using the skills and time of their professional staff.

The Department offers assurances that it will conduct an analysis of the cost-benefits of the data analysis and reporting project at the completion of the development phase and again one year past implementation.

NORTH DAKOTA DEPARTMENT OF PUBLIC INSTRUCTION
Business Case a for Student Data Analysis and Reporting System
Computation of Estimated Productivity Gains

	Number of Staff	Number of Analyses in 4 years per staff	Hours saved per Analysis	Salary and Benefits Average / Yr.	Total Hourly Cost Incl. Benefits	Total Productivity Savings	Total Hours Saved
Productivity							
District & School Personnel	920	70	4	$60,000	$36.06	$9,288,462	257,600
Total Productivity Gains						$9,288,462	257,600
Productivity Gains per Student						$79.17	

Figure 1.

8)   There is another benefit of doing this project, which is improving communications both externally and internally. The use of a student data analysis and reporting system for improved communications provides two significant benefits. The first is the vast increase in the credibility of communications. Using data analysis, gut instinct submits to facts and misjudgments are nearly eliminated through the analysis of pertinent information. The second benefit is based upon the rapidity with which communications can be made with a student data analysis reporting system that is web based. Since most analyses and reports can be completed in minutes, not days, it is possible to be prepared to respond to the media, legislators or the parents right after relevant assessments are made available. Since those communications can be based upon the facts represented in analyzing the test results, state and district leadership will secure an enormous value from being able to communicate with both accuracy and timeliness.

9)   The ability to establish a School Improvement process based upon frequent and reliable measurements provides perhaps the most significant benefit. The students will have improved academic learning and resultant assessments will trend upward because significant diagnoses can now be performed through rapid and flexible data analysis. Using a student data analysis and reporting system, education professionals will be able to conduct longitudinal analyses, analysis of cohorts, and the analysis of individual student's performance at the learner outcome level. Since the analyses can be done extensively and they take such little time, teachers will be able to see trends and symptoms early enough in the education cycle to make rapid and accurate adjustments to the education process. In addition, the use of standard aligned unit measures will enable districts, schools and teachers to be able to measure progress both incrementally, as well as, on an annual basis. This will help teachers adjust lesson plans, content and delivery as needed to meet individual and group needs.

10) In addition, the implementation of this student data analysis and reporting system has the potential for the following benefits:
     - Decreased systems maintenance costs
     - Decreased forms cost
     - Reduced space requirements for files and records
     - Reduced postage costs
     - Reduced photocopy costs

Viable Alternatives

1. Purchase a vendor solution	Recommended Alternative
2. Build custom solution	Alternative not chosen

Alternative # 1 – Purchase a Vendor Solution

Alternative #1 is to purchase a student data analysis and reporting system based upon a central data warehouse model from a reputable K-12 software company that is able to support the full implementation and training of ND state and local staff. This is the recommended alternative because it provides the most cost effective solution with the lesser risk in the long term.

Total Project Costs.

The project cost for this alternative is based upon a preliminary proposal from one of the leading vendors in K-12 data warehousing that also provide a complete data analysis and reporting system. These numbers are providing for planning purposes but were delivered in the context of a firm proposal. Therefore, these costs have substance and validity because they were designed to deliver a system, along with implementation and training services, similar or equal to the scope of the planned project. The Project Costs represent the implementation of 13 data warehouses, 11 large district warehouse, 1 warehouse for all small districts and 1 warehouse for the ND DPI. The Project Costs are as follows:

Vendor Solution Type and Item	One Time Costs	Annual Costs
Software		
License Fees	$700,000	$100,000
Maintenance Fees (including 1 Year Warranty)	No Charge	$245,000
Documentation	No Charge	No Charge
Services		
Initial Data Conversion, Loading and Testing	$120,000	
Hosting Services (including hardware & bandwidth)	$155,000	$155,000
Two Data Loads per Year (Year 2 and after)		$130,000
Training (Training for State, Districts & Schools)	$175,000	
Total Project	$1,150,000	$630,000

Costs to Other Partners or Customers.

The cost of this project to other partners or customers is primarily at initial implementation. There is a requirement for all districts and ND DPI to gather and cleanse historical demographic and assessment information for loading into the data warehouses. These efforts require the attention of 1 part-time resource in each district for the span of 3 months. The initial demand upon this resource is 50% during month 1 and then 10% in months 2-3. Based upon 218 districts, an average salary and benefits of $65,000 per year, this is a total of $827,000 in staff labor across all districts. The Hosting approach precludes the need for additional hardware or system software at ND DPI or in the districts. The other additional cost is the ND DPI and

districts creation of master teachers that would provide the balance of the training, as well as, remedial and replacement training for ND. The cost estimate for this is 5 master teachers throughout the state that would dedicate 30% of their time for a year to make sure that staff development is complete. At an average salary and benefits of $65,000 per year, this is a total of $97,500 of total additional training costs.

Implementation Timetable.

The implementation plan for this Alternative 1 is 18 months from inception of project to completion of training using a Train the Trainer model combined with vendor supplied knowledge transfer. See Figure 2 below for more details.

Basis for the Cost Estimate.

The basis of this cost estimate is information gathered from a 4 year fixed price proposal from TetraData Corporation, as well as, discussions with TetraData personnel in regard to placing the proposal information into the Project Cost format above.

Return on Investment.

The project cost of Alternative 1, i.e. $3M over 4 years, in comparison to the potential savings identified above, i.e. $9M over 4 years, shows a significant ROI on this project. The actual timing of the ROI will not be year for year due to the 18-month implementation across ND. Therefore, breakeven would occur in year 3 and the projected 4-year savings would be realized in the last 30 months. Those 30 months would generate a cost savings of $5M+ compared to the $3M of direct costs and $925,000 of indirect costs.

North Dakota Implementation Plan

Initiation of the Project

Initiation of the Staff Development Efforts

Location	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18

State D/W — DD DA — Data Acquisition — State Trng — Data Cleanse & D/W Build — D/W Test — Install — State Trng

Districts' D/W incl. the Schools' D/W — District Level Training — School Level Training — District Level Training — School Level Training

Fargo — DD DA Data Cleanse & D/W Build — Test — Inst

Bismark — DD DA Data Cleanse & D/W Build — Test — Inst

Grand Forks — DD DA Data Cleanse & D/W Build — Test — Inst

Minot — DD DA Data Cleanse & D/W Build — Test — Inst

West Fargo — DD DA Data Cleanse & D/W Build — Test — Inst

Mandan — DD DA Data Cleanse & D/W Build — Test — Inst

Dickinson — DD DA Data Cleanse & D/W Build — Test — Inst

Jamestown — DD DA Data Cleanse & D/W Build — Test — Inst

Williston — DD DA Data Cleanse & D/W Build — Test — Inst

Devils Lake — DD DA Data Cleanse & D/W Build — Test — Inst

All Others — DD ★ ★ ★ ★ Data Cleanse & D/W Build — D/W Test — Installation

Data Services

- **Data Discovery - Telecon**
- **Data Analysis and Acquisition - On Site in ND** ★ Interaction with small districts is via telecon and Internet/FTP from the State facility.
- **Data Validation, Cleansing, Import and D/W Build - At TetraData facility**
- **Data Warehouse Testing - At TetraData Facility**
- **Installation of Data Warehouse and Security Support - Phone and e-mail Support from TD Facility**

Staff Development

- **State Level Training - On Site in ND**
- **District Level Training - In 10 Districts and then at Regional Sites, either at Districts or Regional Facilities**
- **School Level Training - In 10 Districts and then at Regional Sites, either at Districts or Regional Facilities**

Assumptions

1. There are thirteen data warehouses: 11 custom district data warehouses; 1 consolidated warehouse for 220 districts; and a state D/W.
2. Each data warehouse will have a max of 4 tests, 12 student attributes & the following objects: school, teacher, class, course & student.
3. Each data warehouse will have a start with a maximum of 3 years of history.
4. All data will be delivered in digital format, e.g. ASCII delimited.
5. In each of the 12 data acquisitions, the digital data will be gathered into one ND location prior to Data Analysis and Acquisition begins.
6. The ND state assessment results is provided as one file with all 231 districts' students in that file, stored by district.
7. All source definitions for the data to be acquired is provided to TetraData prior to Data Analysis and Acquisition.
8. Appropriate district or state IT resources are available for interaction with TetraData personnel during Data Analysis and Acquisition.
9. Each district will provide a data warehouse project coordinator who will work with TetraData and the state department personnel.
10. The state data warehouse will be the lowest common denominator of all of the districts' data warehouses.
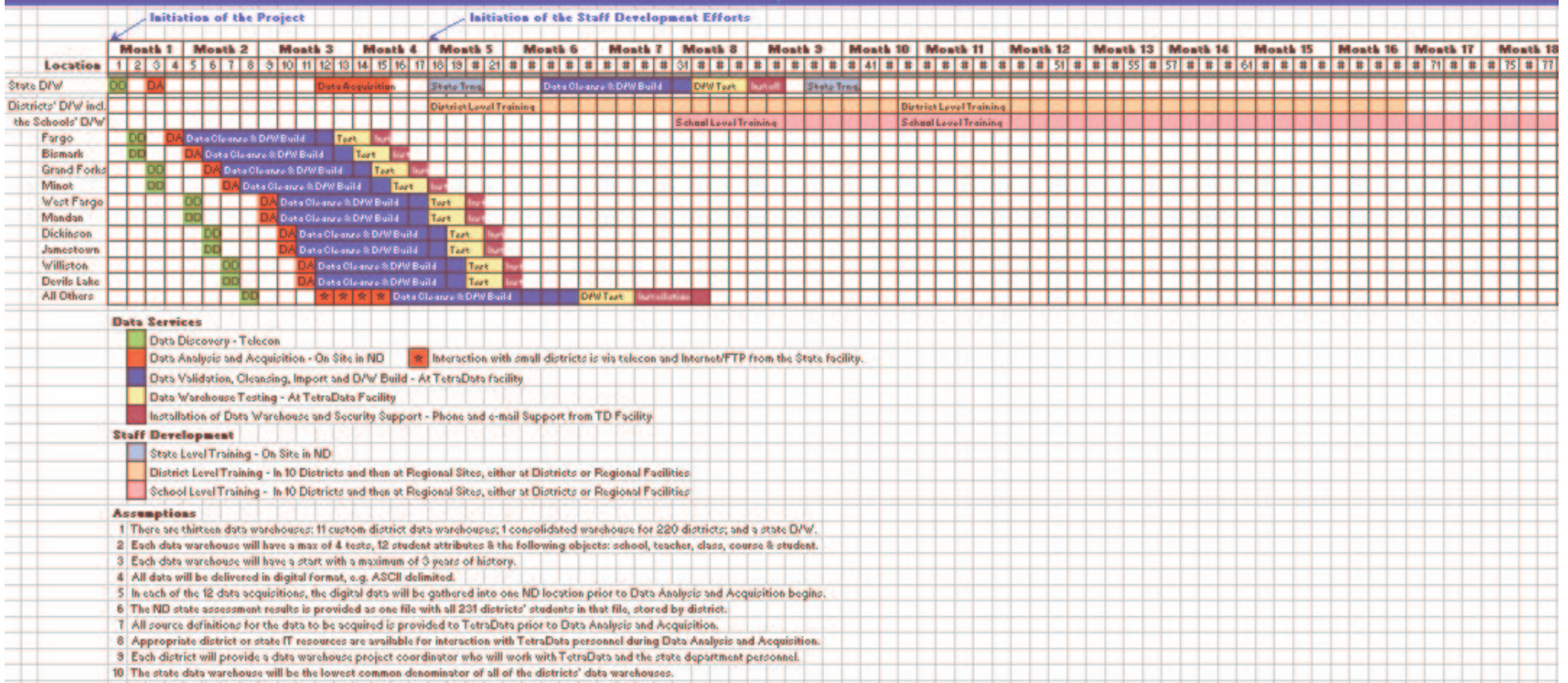
Figure 2.

Alternative # 2 – Build a Custom Solution

Alternative #2 is for ND DPI to either pay a custom provider or to build and utilize internal ITD resources to develop and maintain the data warehouse and all of the data analysis and reporting tools from scratch. This approach is the equivalent of seeking to match the 4+ years that the packaged vendors have invested in their products and then implement the software once stabilized. Estimates for the development of Alternative #2 were derived based on the technical assistance of TetraData Corporation, Greenville, SC.

Total Project Costs.

The project cost for this alternative is based upon the labor required to design, develop, test and document software products that will access a data warehouse, generate queries, provide analyses and publish reports.

Custom Solution Type and Item	Labor Hours Required	One Time Costs	Annual Costs
Software (Labor at $70K/year including benefits)			
Design	6,400	$800,000	
Develop	13,350	$1,200,000	
Test	7,500	$600,000	
Documentation	600	$50,000	
Software Maintenance Staff	1,300	No Charge	$130,000
Help Desk Staff	1,625	No Charge	$65,000
Services			
Initial Data Conversion, Loading and Testing	1,500	$120,000	
Hosting Services (including hardware & bandwidth)	Not Applicable	$155,000	$155,000
Two Data Loads per Year (Year 2 and after)	1,625		$130,000
Training (Training for State, Districts & Schools)	2,300	$175,000	
Total Project	36,200	$3,100,000	$480,000

Costs to Other Partners or Customers.

The cost of this project to other partners or customers is identical to the additional costs if a vendor supplied the data conversion and warehouse build. In addition, the training would be comparable in total cost, although it may make sense to centralize the training. There is a requirement for all districts and ND DPI to gather and cleanse historical demographic and assessment information for loading into the data warehouses. These efforts require the attention of 1 part-time resource in each district for the span of 3 months. The initial demand upon this resource is 50% during month 1 and then 10% in months 2-3. Based upon 218 districts, an average salary and benefits of $65,000 per year, this is a total of $827,000 in staff labor across all districts. The Hosting approach precludes the need for additional hardware or system software at ND DPI or in the districts. The other additional cost is the ND DPI and districts creation of master teachers that would provide the balance of the training, as well as, remedial and replacement training for ND. The cost estimate for this is 5 master teachers throughout the state that would dedicate 30% of their time for a year to make sure that staff

development is complete. At an average salary and benefits of $65,000 per year, this is a total of $97,500 of total additional training costs.

Implementation Timetable.

The implementation plan for this Alternative 3 to 5 years from inception of project to completion of training using a Train the Trainer model combined with vendor supplied knowledge transfer. This is due to the fact that building software is not something that can be developed with mass production due to the limited number of individual products that would be developed in a custom approach. This information comes from observing other states that have attempted similar projects, e.g. Washington State's WAVES project which has been abandoned after 2 years of development.

Basis for the Cost Estimate.

The basis of this cost estimate is information gathered from a data-warehousing expert that has been in the custom software development industry for over 25 years.

Return on Investment.

The project cost of Alternative 2, i.e. $5.02M over 4 years, in comparison to the potential savings identified above, i.e. $9M over 4 years, shows a considerable ROI on this project. The actual timing of the ROI will not be year for year due to the 36+ month implementation across ND. Therefore, breakeven would not occur within the 4 year span. In addition, the additional partner costs of $925,000 would exacerbate the attempt to achieve an ROI within 10 years.

Risk Analysis

As with any new project there are risks. Below are some of the identified risks and processes to help manage and mitigate the risks.

Project Constraints.

There are several project constraints. The premier constraint is the lack of ND DPI funds or separate ND Legislative funding to enable the project to proceed. However, this project totally qualifies for ESEA funding which can overcome funding requirement constraints through 2004. After that time, the districts and/or ND Legislature would have to sustain the project with funding. Depending upon statewide revenue capabilities in 2005 and beyond, funding may be a constraint at that time.

Another project constraint may be the lack of consistent, clean and relevant data at the district/school/teacher/student levels. This will not prevent the project from being productive in the future but would inhibit analyses on current students that have been in the system for several years. Since most effective analyses do rely upon tracking cohorts, a lack of historical information would constrain effective analyses until a history is built.

Identifying Issues During the Project.

The ability to identify issues during the Project will require two things, a ND DPI project manager and a detailed project plan that has meaningful and adequate number of milestones with which to monitor progress. This project manager would establish two levels of project meetings, one that is working team meetings and the other that is executive level meetings. The project manager would use the working team meetings, made up of select DPI and vendor personnel, that would meet frequently, identify new issues, and keep a data base of all open issues with assignments and target resolution. This database would be part of the project management software used to track the system and issue resolution dates, when keyed into the project system, would identify any potential slippage in delivery. The executive level project meetings would be made up of select DPI and representative district executives that would be given charge to make decisions with regard to strategic issues that may arise during the project. The strategic issues would also be added to the project database and tracked in a similar manner to the day-to-day issues. The cost of a project manager is not included into any of the ROI projections because any project manager would be required regardless of the model selected. Therefore, the project manager's impact is comparable to all projections.

Known Risks.

There are several known risks to initiating this project. They are as follows:
- There is a major risk that ND DPI will not be able to address ND legislative accountability requirements if we do not implement this project.
- There is a major risk in not implementing this project. The risk is that we will not be able to leverage available ESEA funds to address the *No Child Left Behind Act* requirements in a timely manner.
- Selecting a data warehouse/data analysis vendor that does not have the products and services needed to deliver the project.

- North Dakota limited experience with data warehousing may leave ND DPI vulnerable to issues that are not easily recognizable.
- Cooperation of the ND districts and schools is fundamental to the success of this project. There is a risk that some ND districts or schools will not participate to the level needed due to a lack of vision or commitment.
- This project will require changes, both in process and the addition of technology. This may evoke resistance from ND DPI personnel, as well as, other staff throughout ND education that need to use the data analysis system.
- The status of ND district and school source data, especially historical data, may be very difficult to gather and cleanse.

Chances of Success.

If the timing of the launch of this project was five years ago, when data warehousing in education was at its inception, the chances of success would be quite low. This would not be due to lack of technical expertise since data warehousing and analysis has been in existence for over a decade in other industries. However, the K-12 education sector had not, as yet, utilized that technology to any extent in managing student data analysis efforts. Now, the industry has data analysis experts, e.g. Dr. Victoria Bernhardt and her work "Data Analysis for Comprehensive Schoolwide Improvement" which was published in 1998, that are driving the use and processes that can leverage data warehousing/data analysis. This five years of experience, along with a national swell of data analysis efforts at state, regional, district and school levels, provides an industry with several data analysis providers and a current history of successes and failures. This provides ND DPI with information from other experiences that greatly increases the chance of success.

Maximizing Chances of Success.

A real key to the success of this project is the ND DPI project manager. A ND DPI staff member should be used for this role since such a person will have the most familiarity with the ND educational landscape and what it will take to make the project a success in the face of the noted risks. A significant addition to ND DPI would be the use of an external data warehouse project manager that has significant experience in education data warehouses to work for the ND DPI project manager for the period of the project. This external resource would be a part time resource, purely consultative in nature, and focused on identifying potential issues throughout the project.

Budget and Schedule Contingency.

Since the vendor selected will be required to provide a fix price on products and services, the primary area of potential cost and time slippage will be with the gathering of data and actual construction of the warehouses. Second, training is an area where achieving critical mass in knowledge transfer may take longer and cost more than planned. Therefore, this plan recommends that there be a $200,000 contingency on the first 2 years data acquisition and cleansing costs and $100,000 on the training efforts. In addition, the schedule can be impacted by both of these items. It is recommended that a 6-month contingency be built into the 18-month schedule to accommodate these concerns.